



HAUPTWERK
VIRTUAL PIPE ORGAN

Hauptwerk V

PREREQUISITES

Platforms and hardware supported for use with Hauptwerk

COMPUTER PLATFORMS

This version of Hauptwerk is supported on Apple Macs running macOS 'Mojave' 10.14 or macOS 'High Sierra' 10.13.6, and on PCs running 64-bit Windows 10 or 64-bit Windows 7.

If you are buying a new computer to run Hauptwerk, we particularly recommend the current range of Apple Macs, including the iMac, iMac Pro, MacBook Pro and Mac Pro, since we have found them to perform very well with Hauptwerk, to be simple to set up and use, and also to be reliable and robust for use with real-time audio and MIDI in general. Above all, because there are only a few models of Macs, and because they're developed and tested as complete units by Apple specifically for real-time audio and MIDI applications, there are far less variables than with PCs, so you can be more confident that you are buying a computer that corresponds closely to one that we've used for testing, benchmarking and developing Hauptwerk, and should thus perform the same for you as it does for us. It also means that you shouldn't have to spend time ironing out compatibility, driver or performance problems.

However, we support Windows platforms equally, as we have since Hauptwerk's was first launched. Buying a PC that has been specifically built and tested by a specialist vendor for optimum 'pro' real-time audio/MIDI/Hauptwerk compatibility and performance, with a support/maintenance agreement, can be an equally good choice.

PROCESSORS

Hauptwerk is fully optimized for modern multi-core processors. Very roughly speaking, the more CPU cores, the more recent the processor model, the faster the processor's base frequency (its GHz speed), the more CPU cache, and the better the CPU AVX instruction set version it supports (AVX, AVX2, or Intel AVX-512), the larger the number of organ pipes that are likely be able to sound at once in Hauptwerk, and the better it should be able to handle large numbers of audio channels and real-time impulse response reverbs for the Hauptwerk Advanced Edition.

On both Mac and PC platforms, recent Intel processors in the i9, i7, or equivalent Xeon ranges of processors (with AVX2 or AVX-512 CPU instruction set support), with at least four CPU cores and at least 8 MB of CPU cache, are particularly recommended for best performance with large or complex organs in Hauptwerk, and for large numbers of audio channels and real-time impulse response reverbs for the Hauptwerk Advanced Edition.

On the PC platform, Hauptwerk is compatible with 64-bit Intel and 64-bit AMD (x64-architecture) processors. We particularly recommend recent Intel processors for maximum performance; recent AMD models are also good, but in our experience recent top-end Intel processors out-perform the top-end AMD processors for Hauptwerk at the time of writing.

Although fast modern processors enable large or-

gans to be used, they are not requirements, and even a PC with dual-core 2 GHz processor should give sufficient performance for many small organs with all of Hauptwerk's features enabled, or larger organs if some realism features are disabled (such as swell box filters).

MEMORY

Hauptwerk deliberately does not stream samples from hard-disk/SSD in order to achieve the high polyphony necessary for a pipe organ, so it's important that you have sufficient free memory (RAM) in order to be able to load each organ that you intend to use within Hauptwerk fully into RAM.

An absolute minimum of 2 GB of memory is required to use Hauptwerk with the included St. Anne's organ. Most sample sets state the memory they require as a prerequisite. In order to be able to use a reasonable selection of current sample sets, 16 GB or more of memory is recommended. If you are buying a new computer specifically to run Hauptwerk, we recommend at least 32 GB.

Note that you can choose to load only some ranks of pipes into memory. Other per-rank memory-saving options are also available.

STORAGE (HARD-DISK OR SSD)

An absolute minimum of 6 GB of free storage space is required to use Hauptwerk with the standard St. Anne's, Moseley organ sample set installed by default. Other sample sets will re-

quire additional space. We recommend ensuring that you have at least 50-400 GB free if you wish to use a number of different sample sets.

The speed of your storage only determines the time it will take Hauptwerk to load a sample set; real-time performance should not be affected once the sample set is loaded into memory. SSD drives or RAID 5 hard-disk arrays can be used if you want sample sets to load quickly. (RAID 5, RAID 1 or RAID 0+1 may also make your system more resilient to the failure of a hard disk.)

If you are installing Apple macOS from scratch (not usually required), we recommend using the default file system during installation, and avoiding the 'case sensitive' file system (a custom installation option) since some Hauptwerk sample sets might not be compatible with it. On Windows, the NTFS file system (which is the default) is required. (The older FAT32 file system doesn't support files larger than 4 GB and thus prevents some large sample sets from installing properly.)

OPERATING SYSTEMS

On the Mac platform, Hauptwerk is compatible with, and fully supported on, Macs running either:

- MacOS 'Mojave' 10.14.
- MacOS 'High Sierra' 10.13.6 and above.

(It might possibly still work on OS X 10.12 or 10.11, but we'll only provide support on them for issues that can be reproduced on one of our primary supported Mac platforms listed above, and that don't appear to be related to the platform. Hauptwerk cannot be installed or used on

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OS X versions 10.10 or earlier, or on PowerPC Macs, or on 32-bit Macs.)

On the Windows platform, Hauptwerk is compatible with, and fully supported on, PCs running either:

- 64-bit Windows 10 (Professional or Home editions).
- 64-bit Windows 7 (Professional, Ultimate, or Home Premium Editions), Service Pack 1 and above.

(It might possibly work on some other 64-bit pre-Windows 10 versions of Windows, but we'll only provide support on them for issues that can be reproduced on one of our primary supported Windows platforms listed above, and that don't appear to be related to the platform. Hauptwerk cannot be installed or used on 32-bit versions of Windows, or on 32-bit PCs.)

Memory limits for the supported Windows versions are:

- 64-bit Windows 10 (Professional edition): 512 GB.
- 64-bit Windows 10 (Home edition): 128 GB.
- 64-bit Windows 7 (Professional or Ultimate editions): 192 GB.
- 64-bit Windows 7 (Home Premium edition): 16 GB.

All editions of Windows 10 and Windows 7 support multi-core processors. However, support for two separate physical processors is only in-

cluded in Windows 10, and in Windows 7 Professional and Ultimate editions.

Please ensure that drivers are available for all of your hardware on the operating system you wish to use.

OPERATING SYSTEM PATCHES

All current operating system updates, service packs and driver updates should be applied when they are available. Hauptwerk might not be able to install or run unless current operating system updates have been applied. On Windows/PCs, also make sure that the latest drivers are installed for your motherboard and graphics card and that the latest BIOS is installed for the motherboard.

JAVA

Hauptwerk's installer includes and uses Java internally (but Hauptwerk itself doesn't).

AUDIO INTERFACES

In principle, any audio or sound interface, which is supported by the manufacturer on your operating system and hardware, and has good drivers, should work. Professional or semi-professional audio interfaces with high-quality digital-to-analog converters and drivers are strongly recommended above consumer-level sound cards for best quality, reliability, performance and minimal delay between pressing a key and hearing the sound ('latency').

macOS has high-performance, professional-

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grade, low-latency real-time audio and MIDI support built in, so driver, performance or compatibility problems are uncommon (and even Macs' built-in audio outputs should perform well by default).

On the Windows/PC platform the quality and compatibility of the drivers and components is particularly important for reliable low-latency real-time audio and MIDI performance. Either ASIO or DirectSound drivers can be used, but good-quality manufacturer-supplied ASIO drivers are strongly recommended for best performance. The freeware ASIO4All driver sometimes makes it possible to get reasonable performance from PCs' built-in audio outputs and other consumer-level audio hardware if no ASIO driver is available from the manufacturer.

An audio interface and ASIO/Core Audio driver that natively supports power-of-two buffer sizes (128, 256, 512, 1024, 2048, or 4096) is recommended for lowest latency.

Any audio interface you use must natively support the sample rates used by the organs you wish to load into Hauptwerk (typically 48 kHz, 44.1 kHz and 96 kHz).

Since it's impossible for us to test with all products, we recommend evaluating any candidate audio interface with Hauptwerk before purchasing it. Ensure that the interface is supported by its manufacturer on your computer platform and that you install the latest drivers for it, which can usually be downloaded from the manufacturer's website.

Current audio interfaces from the following ranges are popular with Hauptwerk users on both Macs and PCs:

- MOTU AVB, Thunderbolt, and USB interfaces.
- RME AVB and USB interfaces.
- PreSonus Thunderbolt and USB interfaces.
- M-Audio USB interfaces.

(Not all PCs support AVB natively, but the RME Digiface AVB interface allows AVB audio interfaces indirectly to connect via a PCs' USB 3 port. Likewise, not all PCs have Thunderbolt ports, but PC Thunderbolt cards and adapters are available. Please check with the maker of your audio interface and PC to ensure compatibility.)

If you want to use multi-channel audio output (Hauptwerk Advanced Edition) then the number of analog audio outputs that an audio interface provides will usually determine the maximum number of speakers that you will be able to use. Multiple AVB interfaces can usually be connected together and used at once for large numbers of audio channels.

MIDI INTERFACES

You will need a MIDI interface or USB music keyboard if you want to play Hauptwerk live (although you can evaluate it without one by clicking on the keys on the screen). Any MIDI interface supported by the manufacturer on your operating system and hardware should work with Hauptwerk. Good-quality professional or semi-professional MIDI interfaces are rec-

ommended above budget consumer-level USB-MIDI adapters for best performance and reliability, particularly for the avoidance of 'stuck notes'.

macOS has high-performance, professional-grade low-latency audio and MIDI support built in, so driver, performance or compatibility problems are uncommon.

On the Windows/PC platform the quality and compatibility of the drivers and components is particularly important for reliable audio and MIDI performance.

Many audio interfaces include MIDI IN and MIDI OUT ports anyway. If yours does, you probably won't need a separate dedicated MIDI interface unless you need extra MIDI ports to connect several MIDI devices to the computer simultaneously (such as multiple MIDI keyboards, or complex MIDI organ consoles).

Since it's impossible for us to test with all products, we recommend evaluating any candidate MIDI interface with Hauptwerk before purchasing it. Ensure that the interface is supported by its manufacturer on your computer platform and that you install the latest drivers for it, which can usually be downloaded from the manufacturer's website.

On both Macs and PCs the following dedicated MIDI interfaces are popular and well-proven for Hauptwerk, all of which connect to the computer via USB:

- MOTU Micro Lite (USB): 5 MIDI input ports, 5 MIDI output ports.
- MOTU Express 128 (USB): 8 MIDI input ports, 8 MIDI output ports.

- M-Audio MIDISPORT 2x2 Anniversary Edition (USB): 2 MIDI input ports, 2 MIDI output ports.

- M-Audio MIDISPORT 4x4 Anniversary Edition (USB): 4 MIDI input ports, 4 MIDI output ports. Details of the interfaces can be found on the MOTU and M-Audio websites.

MONITORS AND GRAPHICS CARDS

For traditional-DPI (non-'Retina') monitors: Hauptwerk requires a minimum display resolution of 1024 pixels horizontally by 900 pixels vertically for your (primary) monitor. For high-DPI monitors (such as Apple 'Retina' displays): Hauptwerk requires a minimum display resolution of 1536 pixels horizontally by 1350 pixels vertically for your (primary) monitor. Some sample sets may require higher resolutions to display at their optimal resolutions but Hauptwerk can zoom them to fit your screen.

Touch-screens are very popular for use with Hauptwerk, since they provide a simple and effective interface to control Hauptwerk's stops, avoiding the need for MIDI draw-knobs/tabs, etc. or any complex MIDI configuration. Many Hauptwerk users use MIDI piston buttons to trigger Hauptwerk's combinations and a touch-screen to program those combinations, which is very simple to configure but convenient for performance. Hauptwerk's user interface is designed to support touch-screen use throughout. The Advanced Edition of Hauptwerk has native support for up to four monitors, including touch-screens, allowing different virtual console windows to be shown on separate physical monitors. For example you could display stop

jambes on either side of your MIDI keyboards using two monitors.

Hauptwerk also has native support for Novation Launchpads (specifically, the 'Launchpad Mark 2' model, and the original 'Launchpad' mark 1 model), which are good, popular, similarly-easy and convenient alternatives to touch-screens. They have a grid of robust buttons with multi-color LEDs in them that Hauptwerk can control natively to show stop states and functional groupings (by color). You can assign any button to any stop or piston in Hauptwerk and select the LED color you prefer for each, separately for each virtual organ. Hauptwerk also natively supports multiple Launchpad units, so that you could use one for each stop jamb, for example.

VST AND AUDIO UNIT HOSTS (ADVANCED EDITION ONLY)

The Hauptwerk Advanced Edition has native support for applying real-time impulse response reverb, so no external VST or Audio Unit hosts or plug-ins, or other software or hardware, are needed for that. However, if so desired, the Advanced Edition's Hauptwerk AU/VST Plug-in Link does allow you to stream audio to an external VST/AU host for applying VST/AU audio effects plug-ins, and/or to stream MIDI into Hauptwerk for MIDI sequencing/composing purposes. On macOS the Hauptwerk VST Link is fully supported and tested with the following VST hosts:

- Steinberg Cubase 10.x (64-bit). (2)
- Cockos Reaper 5.9x (64-bit).

On macOS the Hauptwerk AU Link is fully supported and tested with the following Audio Unit hosts:

- Apple Logic Studio Pro X 10.4.x (1) (2)
- Apple Garage Band 10.3.x (1) (2)
- Cockos Reaper 5.9x (64-bit).

On Windows the Hauptwerk VST Link is fully supported and tested with the following VST hosts:

- Steinberg Cubase 10.x (64-bit). (2)
- Cockos Reaper 5.9x (64-bit).

(1) This host doesn't support any MIDI output from plug-ins of this type (VST/AU), so can't be used to record MIDI output streamed directly from Hauptwerk via the Hauptwerk VST/AU Link. If you want to do that (which is uncommon), then instead you need to use a virtual MIDI cable to connect Hauptwerk to the host.

(2) This host doesn't support MIDI sys-ex with plug-ins of this type (VST/AU). If you want to do that, then instead you need to use a virtual MIDI cable to connect Hauptwerk to the host. (The Hauptwerk VST/AU Links should in principle be compatible with the majority of other VST and Audio Unit hosts, but we'll only provide support on them for issues that can be reproduced on one of our primary supported hosts.) Please note that we can't provide support with how to use or configure VST and Audio Unit hosts, plug-ins, or MIDI sequencers, beyond the information provided in this guide and on our website.

OTHER MIDI SEQUENCER SOFTWARE

In principle, any MIDI sequencer software should be compatible with Hauptwerk. A 'virtual MIDI cable', or a physical MIDI cable and associated spare MIDI ports, are required to connect Hauptwerk to a non-VST/AU MIDI sequencer running on the same.

macOS includes virtual MIDI cable functionality natively, called the 'IAC Driver', but it's disabled by default. If you wish to use it, navigate to /Applications/Utilities/Audio MIDI Setup, select Show MIDI window from its Window menu, double-click on the IAC Driver icon, ensure that its Device is online property is ticked, click the Add button to increase the number of ports to at least two, then click Apply and select Audio MIDI Setup | Quit Audio MIDI Setup from the menu. On Windows platforms a third-party program is required, such as loopMIDI.

Please note that we can't provide support with how to use or configure VST and Audio Unit hosts, plug-ins, or MIDI sequencers, beyond the information provided in this guide and on our website.

MIDI KEYBOARDS, ORGAN CONSOLES AND MIDI CONTROLLERS

To play Hauptwerk 'live' you need at least one MIDI keyboard, or a MIDI organ console, plus MIDI lead(s) to connect it to the computer's MIDI interface. Alternatively you can use one or more USB music keyboards (or you can evaluate Hauptwerk just clicking on the keys on the screen). Hauptwerk is designed to be natively compatible with the MIDI implementations

found in the majority of digital and electronic organs, so that MIDI draw-knobs, pistons, swell shoes and so forth can control Hauptwerk and be controlled by Hauptwerk where the hardware allows it, and Hauptwerk should be able to configure MIDI settings automatically. Please see the 'MIDI implementation' and 'Playing Hauptwerk live from a digital organ' sections in the main Hauptwerk user guide for details of the MIDI implementations supported by Hauptwerk.

As noted above, touch-screens are very popular for use with Hauptwerk, since they provide a simple and effective interface to control Hauptwerk's stops, avoiding the need for MIDI draw-knobs/tabs, etc. or any complex/expensive MIDI equipment. Many Hauptwerk users use MIDI piston buttons to trigger Hauptwerk's combinations and touch-screens to program those combinations, which is very simple to configure but convenient for performance. Hauptwerk has native support for up to four monitors (1), including touch-screens, allowing different virtual console windows to be shown on separate physical monitors. For example you could display stop jams on either side of your MIDI keyboards using two monitors.

Hauptwerk also has native support for Novation Launchpads (specifically, the 'Launchpad Mark 2' model, and the original 'Launchpad' mark 1 model), which are good, popular, similarly-easy and convenient alternatives to touch-screens. They have a grid of robust buttons with multi-color LEDs in them that Hauptwerk can control natively to show stop states and functional groupings (by color). You can assign any button to any stop or piston in Hauptwerk and select the LED color you prefer for each, separately for each virtual organ. Hauptwerk also natively supports multiple Launchpad units, so that you

could use one for each stop jamb, for example. (1) Multiple monitor support is only available with the Advanced Edition of Hauptwerk. Amplifiers, speakers and headphones Hauptwerk produces audio output signals through the computer's audio interface(s). Amplifiers and loudspeakers or headphones will then be required to turn those signals into sound.

The quality of the audio amplifiers and speakers is very important; there's little point spending a lot of money on a computer and audio interface and then using computer speakers – the results will almost certainly be disappointing. At the very least, a good quality stereo hi-fi amplifier and pair of speakers should be used, or good quality hi-fi headphones. Recording studio monitor speakers are usually good alternatives. For amplification in large buildings, it's often better to have many smaller high-quality amplifiers and speakers than a few high-powered ones. Hauptwerk fully supports multi-channel audio output (1), so you can amplify different organ ranks, or parts of ranks, separately if you wish and have a multi-output audio interface. You can also distribute pipes within groups of available channels. This enables a three-dimensional sound to be created and helps to minimize some types of distortion inherent in loudspeakers. It is usually the preferred method of amplification with dry sample sets used in reverberant spaces. (1) Multi-channel audio output is only available with the Advanced Edition of Hauptwerk.

ILOK3/ILOK2 DONGLE AND SPARE USB PORT, OR ALWAYS-ON INTERNET CONNECTION FOR ILOK CLOUD LICENSING

Hauptwerk is licensed either by means of an iLok3/iLok dongle, or via 'iLok Cloud' – you can choose to activate your license(s) to either, and you can freely move licenses around between them. Those licensing methods are covered in the 'Licensing, editions, and technical support' section in the main Hauptwerk user guide. If you choose to use iLok Cloud then no hardware dongle is required, but your Hauptwerk computer must have a reliable Internet connection that's available all of the time that Hauptwerk is running.

If instead you prefer a hardware dongle, or if your Hauptwerk computer doesn't have a reliable always-on Internet connection, then you will instead need an iLok3 (or iLok2) USB dongle, and a spare USB port to which to attach it. An iLok dongle isn't included with Hauptwerk, but iLok3 dongles may be purchased readily (without licenses in them) from musical equipment shops for a modest cost. If you already have an iLok3/iLok2 dongle for another product, then you can also use that dongle for Hauptwerk; licenses for multiple software products from different companies may coexist within any given dongle. If you use an iLok3/iLok2 dongle, and if your Hauptwerk computer doesn't have an Internet connection at all, then licenses within the dongle may be updated by temporarily moving the dongle to a separate Internet computer

(which has the iLok License Manager software installed) whenever needed. The dongle may be moved freely around amongst several computers, provided that the dongle is attached to whichever computer has Hauptwerk running at the time.

If you don't have sufficient spare USB ports on your computer itself, then we recommend only using good-quality USB hubs with dedicated power supplies to ensure that the iLok dongle (and any other USB hardware) functions reliably. (Please note that the previous 'Hauptwerk USB key' HASP dongle that was used for Hauptwerk versions 2-4, cannot be used for licensing this version of Hauptwerk, or for licensing sample sets.)

ILOK LICENSE MANAGER SOFTWARE AND ILOK ACCOUNT

In order to use Hauptwerk, you need to have the iLok License Manager software installed, and you need to have/create an iLok account. For both of those things, please visit <https://www.ilok.com/>.

ADOBE ACROBAT READER

Hauptwerk's documentation is in Adobe PDF format. macOS and Windows 10 can display PDF documents natively, but on Windows 7 you need to make sure that you have the latest version of Adobe Acrobat Reader installed. It can be downloaded from Adobe's website.

GENERAL NOTES ABOUT HARDWARE AND SOFTWARE

COMPATIBILITY

Important note 1: Since it is not possible for us to test with all combinations of hardware and third-party software, we would recommend testing Hauptwerk as an evaluation, and/or evaluating any candidate hardware, with your system before purchasing.

Important note 2: Milan Digital Audio does not make or sell computer hardware. We hope you find any recommendations we give useful as reference but we cannot guarantee that any given combination of hardware components or drivers will work or perform well together, regardless of whether some of them follow our recommendations. We are sorry we cannot provide a significant level of help or advice for computer hardware, beyond the recommendations made in the user guide and on our website. If you need help or support with building PCs, using computers, or buying, installing or using PC components, then please make sure that you have a support contract with a company that can provide that support. If you are considering buying a computer to run Hauptwerk and you do not have much experience with building computers, diagnosing driver and hardware compatibilities, and so forth, then we would recommend either buying an Apple Mac (Apple Macs should give reliable performance 'out of the box') or buying a PC from a company that offers ready-made high-performance PCs specifically designed, tested and supported for use with Hauptwerk. The MIDI hardware section on our website may be found by visiting www.hauptwerk.com/hardware and lists several such companies. **HW**